INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LDS-P-SERIES

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LDS-P-SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LDS-P models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LDS-P

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SPECIFICATIONS AND FEATURES

D.C. OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I

MODEL	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS)* AT AMBIENT TEMPERATURE			INPUT POWER (WATTS)**
		40°C	50°	60°C	
LDS-P-5-OV	5 ± 5%	22.0 (20.9)	18.8 (18.0)	15.6 (14.8)	345
LDS-P-12	12 ± 5%	14.0 (13.3)	12.4 (11.8)	10.0 (9.5)	380
LDS-P-15	15 ± 5%	12.0 (11.4)	10.6 (10.0)	8.5 (8.1)	395
LDS-P-20	20 ± 5%	10.0 (9.5)	8.9 (8.5)	7.0 (6.6)	405
LDS-P-24	24 ± 5%	9.0 (8.5)	8.0 (7.6)	6.0 (5.7)	410
LDS-P-28	28 ± 5%	8.0 (7.6)	7.1 (6.7)	5.2 (4.9)	425
LDS-P-48	48 ± 5%	4.5 (4.28)	4.0 (3.8)	3.4 (3.2)	420
LDS-P-01	0 - 7	9.5 (9.0)	8.5 (8.0)	7.5 (7.1)	175
LDS-P-02	0 - 18	4.5 (4.3)	4.0 (3.8)	3.3 (3.1)	170
LDS-P-03	0 - 32	2.7 (2.5)	2.5 (2.4)	2.3 (2.2)	160
LDS-P-100	100 ± 5%	1.6†	1.4†	1.2†	270
LDS-P-120	120 ± 5%	1.4†	1.2†	1.0†	270
LDS-P-150	150 ± 5%	1.1†	0.9†	0.8†	270

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

*Ratings apply for use with cover removed. Use ratings in parentheses when unit is used with cover. Refer to figure 12 for cover removal.

**With output loaded to full current rating and input voltage 127 volts AC, 60 Hz.

†With or without cover.

REGULATED VOLTAGE OUTPUT

Regulation (Line) . . . . . 0.005% +0.5 mV for input variations from 105-127, 127-105, 210-254, or 254-210 volts AC.

Regulation (Load) . . . . . 0.005% +0.5 mV for load variations from no load to full load or full load to no load.

Ripple and Noise . . . . . 150 μ V rms, 1 mV peak to peak for LDS-P-5-OV thru -48-OV and LDS-P-01, 02, 03; 250 μ V rms, 1 mV peak-to-peak for LDS-P-100, 120, 150 with either positive or negative terminal grounded.

Temperature Coefficient . . . . . Output change in voltage ±(0.005% +10 μV)/°C on 01, 02, 03 with external programming resistors; ±(0.01% +10 μV)/°C on 01, 02, 03 with internal programming resistors and on 5V thru 150V units.

Remote Programming

External Resistor	Nominal 1000 ohms/volt output. Downward programming to voltages less than 1.0 volt must be accomplished in two steps; first, from original voltage value to 1.0 volt, and then from 1.0 volt to final desired value less than 1.0 volt.
Programming Voltage	One-to-one voltage change.
Remote Sensing	Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

AC INPUT — 105-127 or 210-254 volts AC at 47-440 Hz. Standard LDS-P power supplies are factory wired for 105-127 volt input, but can be rewired for 210-254 volt input. See figure 8 and schematic diagram for rewiring of AC input. For input power see table I. Ratings apply for 57-63 Hz input. For 47-53 Hz input, derate 40° C rating by 10%. For 63-440 Hz input consult factory.

OVERLOAD PROTECTION

Thermal	Thermostat, resets automatically when over temperature condition is eliminated.
Electrical	Automatic electronic current limiting circuit, limits output current to a safe value. Automatic current limiting protects the load and power supply when direct shorts occur.

OVERVOLTAGE PROTECTION — Model LDS-P-5-OV includes a fixed built-in overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Overvoltage protection range varies between 6.3 and 6.9 volts DC.

ISOLATION RATING — 10 megohm isolation minimum from DC to ground at 1000 VDC.

INPUT AND OUTPUT CONNECTIONS — Refer to figure 12 for location.

AC input	Screw terminals on printed circuit board
Ground	Terminal on transformer
DC output	Screw terminals on printed circuit board; solder turret provided for remote programming operation.
Sensing	Screw terminals on printed circuit board

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0° C to 60° C ambient with corresponding load current rating for all modes of operation.

STORAGE TEMPERATURE (non-operating) — -55° C to +85° C

TRANSFORMER — MIL-T-27C, Grade 6; electrostatic shield; 4,000 VAC input/output isolation.

FUNGUS — All LDS-P power supplies are fungus inert.

DC OUTPUT CONTROL — Screwdriver voltage adjust control permits adjustment of DC output voltage. Refer to figure 12 for location of control. On wide range models, an adjustment range of 1% V_o max to V_o max is provided by the internal programming potentiometer; programming over the full 0 to V_o max range can be accomplished by remote programming.

PHYSICAL DATA

Size	11" x 4-7/8" x 4-13/32" with or without cover in place
Weight	14 lbs. net., 15-1/2 lbs. shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — One surface, with tapped mounting holes, can be utilized for mounting this unit. The supply must be mounted with top side facing up, in horizontal plane.

ACCESSORIES

Overvoltage Protector	Internally mounted L-35-OV-5 series overvoltage protector, standard on 5V unit. Internally mounted L-20-OV series overvoltage protectors optional on LDS-P-12 thru LDS-P-28; overvoltage protector L-35-OV-6 optional on LDS-P-6 and overvoltage protector LMOV-3 optional on model LDS-P-48. LHOV series adjustable overvoltage protector accessory optional for models LDS-P-01 through LDS-P-03.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When load exceeds 105% of 40°C rating, both voltage and current decrease until voltage reaches zero and the current at short circuit equals approximately 20 percent or less of the rated current. (For wide range models, 01, 02 and 03 short circuit current equals the rated current).

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminals provided. Apply input power to AC terminals; always connect the ungrounded (hot) lead to terminal indicated in figures 3 through 9.

The supply positive terminal is brought out to terminal +V. The supply negative terminal is brought out to terminal -V. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks as shown in figure 11. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for application with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf, elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 1000 ohms/volt change and shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation. On wide range models, downward

programming to voltages less than 1.0 volt must be accomplished in two steps: first from original voltage value to 1.0 volt and then from 1.0 volt to final desired value less than 1.0 volt.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 2 ma. minimum.

Alternatively, when supplies with less than 2 ma. reverse current capability are used, a resistor capable of drawing 2 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LDS-P power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of "Specifications and Features", for power supply current and voltage ratings.

Connections For Parallel Operation, Figure 9 (Applicable only to LDS-P-01 — LDS-P-03)

The current capability of LDS-P power supplies can be extended by parallel operation of LDS-P power supplies of equal* voltage capacities.

Units "M" and "S" are shown connected for parallel operation in figures 9A and 9B. One power supply, designated the "M" unit, controls its own output as well as the output of the second power supply, designated the "S" unit.

*For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit S operates to regulate its current in a ratio to that of the M unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

> CAUTION: Always set "S" unit voltage control to zero (fully CCW) during parallel operation, otherwise excessive current will flow through "M" unit voltage control.

MOUNTING OF OPTIONAL OVERVOLTAGE PROTECTOR ACCESSORIES

Mount L-20-OV and L-35-OV protectors to the power supply using two 6-32 x 3/8" pan-head screws and 2 #6 split lockwashers. Overvoltage protectors LMOV-3 and LHOV series have 6-32 captive screws for mounting the protector to the chassis.

Two 6-32 threaded holes are available on the chassis adjacent to the transformer for mounting the OV protector.

After mounting, connect wires from overvoltage protector +V terminal to +V terminal on printed circuit board and from -V to -V terminal on printed circuit board. For models LDS-P-01 thru LDS-P-03 and LDS-P-48, which use LHOV and LMOV protectors respectively, two tie points, adjacent to the transformer, and provided for use as intermediate connection points between the protector and the unit output voltage terminals. Protector red lead connects to one tie point and unit +V output terminal and protector black lead connects to other tie point and unit -V output terminal.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Overvoltage Shutdown (LDS-P-5-OV only)

When the power supply output voltage increases above the overvoltage limit, the protector will short circuit output of the supply. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input circuit.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda LDS-P power supply. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check fuse, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 11 as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuits components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any function is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 11. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-127 or 127-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 893AB or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output. Connect oscilloscope probes directly across the +V and -V output terminals. Position probes upward and take care to use short probe leads placed away from any other wires.

ADJUSTMENT OF CALIBRATION CONTROL R105

Whenever R104, R105, R106, R124, R1A, R1B, R2B, R3, R4 or IC101 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R105 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R105 from resistor housing.

3. Operate power supply for constant voltage with local sensing, connected as shown in figure 3 with no external load.

4. Turn voltage adjust control until minimum rated output voltage is obtained.

5. Apply load so that output current is 105% of 40°C rating for the unit. It may be necessary to turn R105 CW in order to achieve this value of current.

6. Using a DVM John Fluke 891A or equivalent, observe output voltage while adjusting R105 in CCW direction. Adjust R105 until output voltage begins to decrease.

7. Turn voltage adjust control until maximum rated output voltage is obtained.

8. Increase load. Maximum attainable load current shall not exceed 110% of 40°C rating for the unit.

9. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R105 to resistor housing.

10. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location, of the part.

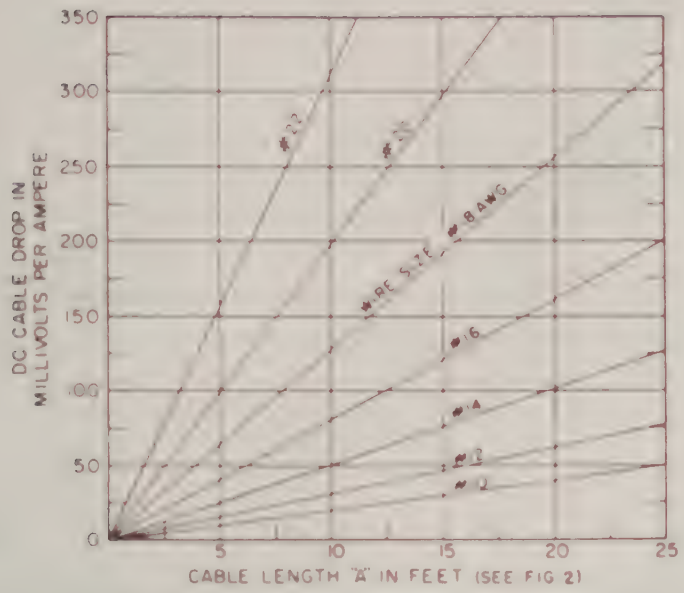


Figure 1. Cable Connection Chart

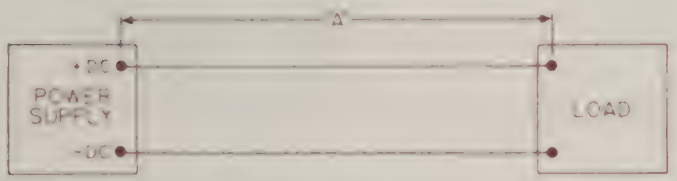
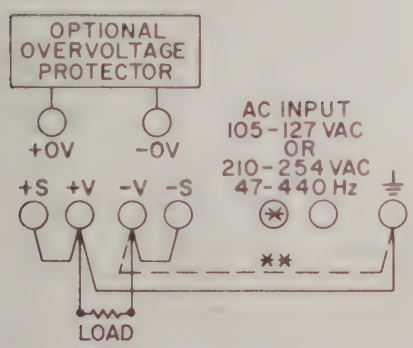


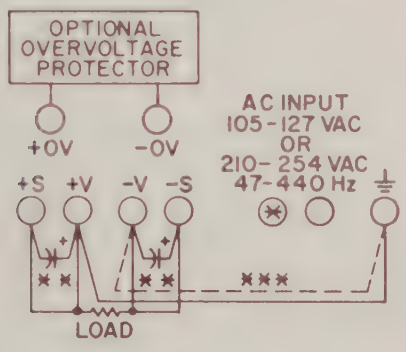
Figure 2. Cable Length "A" in Feet



* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

Figure 3. Local Sensing Connection.

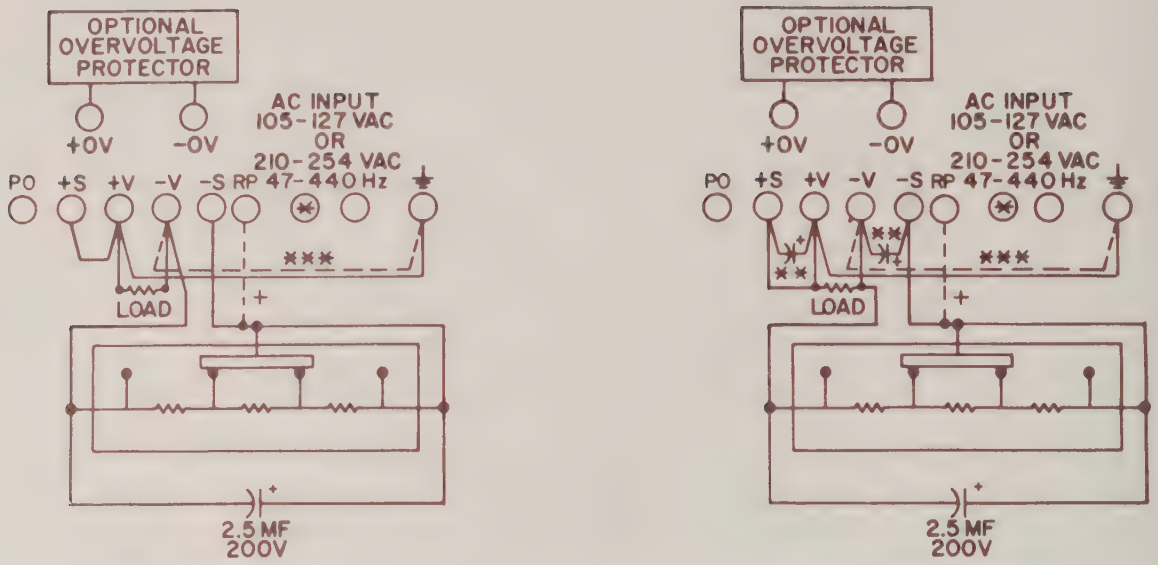


* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED

*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

Figure 4. Remote Sensing Connection.



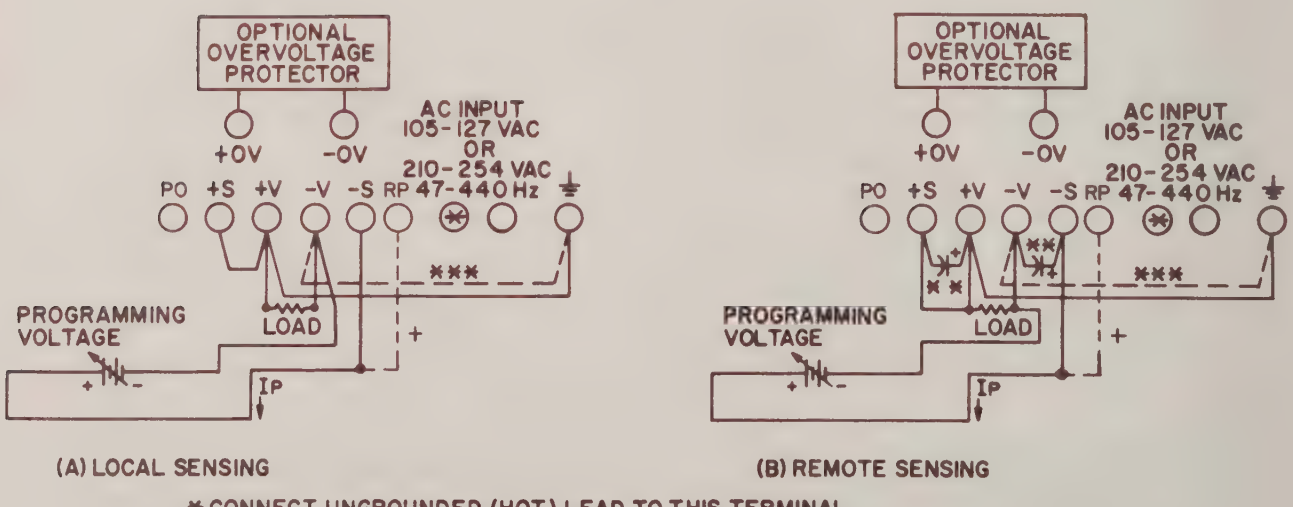
* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

+ LDS-01,02,03 ONLY, USE RP TERMINAL INSTEAD OF -S; -S IS LEFT OPEN.

Figure 5. Programmed Voltage, With External Resistor.



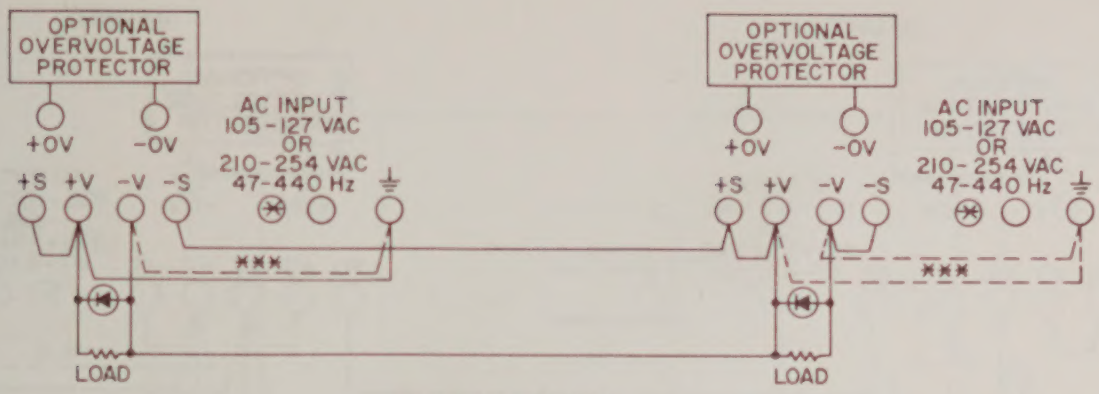
* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

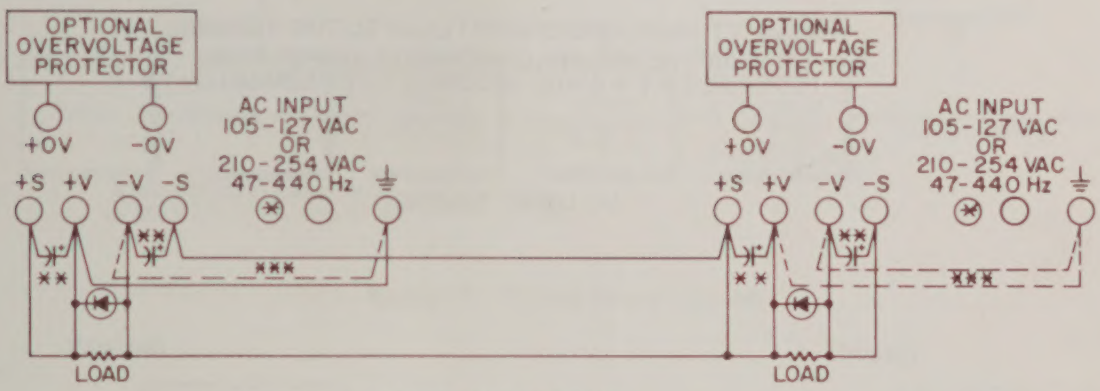
*** FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS +V & ⏚ AND RECONNECT TO TERMINALS -V & ⏚.

+ LDS-01,02,03 ONLY, USE RP TERMINAL INSTEAD OF -S; -S LEFT OPEN.

Figure 6. Programmed Voltage, With External Programming Voltage Source.



(A) LOCAL SENSING



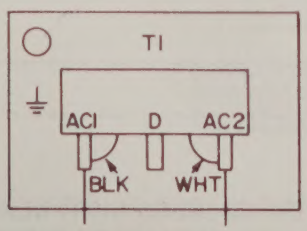
(B) REMOTE SENSING

* CONNECT UNGROUNDED (HOT) LEAD TO THIS TERMINAL.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

*** MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS +V & ⏚ ON LEFT UNIT AND CONNECT ANY ONE OF THE JUMPERS AS SHOWN IN DOTTED LINE.

Figure 7. Series Connection.



CONNECTION SHOWN IS FOR 105-127 VAC. FOR 210-254V INPUT, DISCONNECT BLK & WHT TRANSFORMER LEADS FROM TERMS ACI & AC2 AND RECONNECT BOTH LEADS TO TERM D.

Figure 8. Transformer Connections for AC Input Conversion.

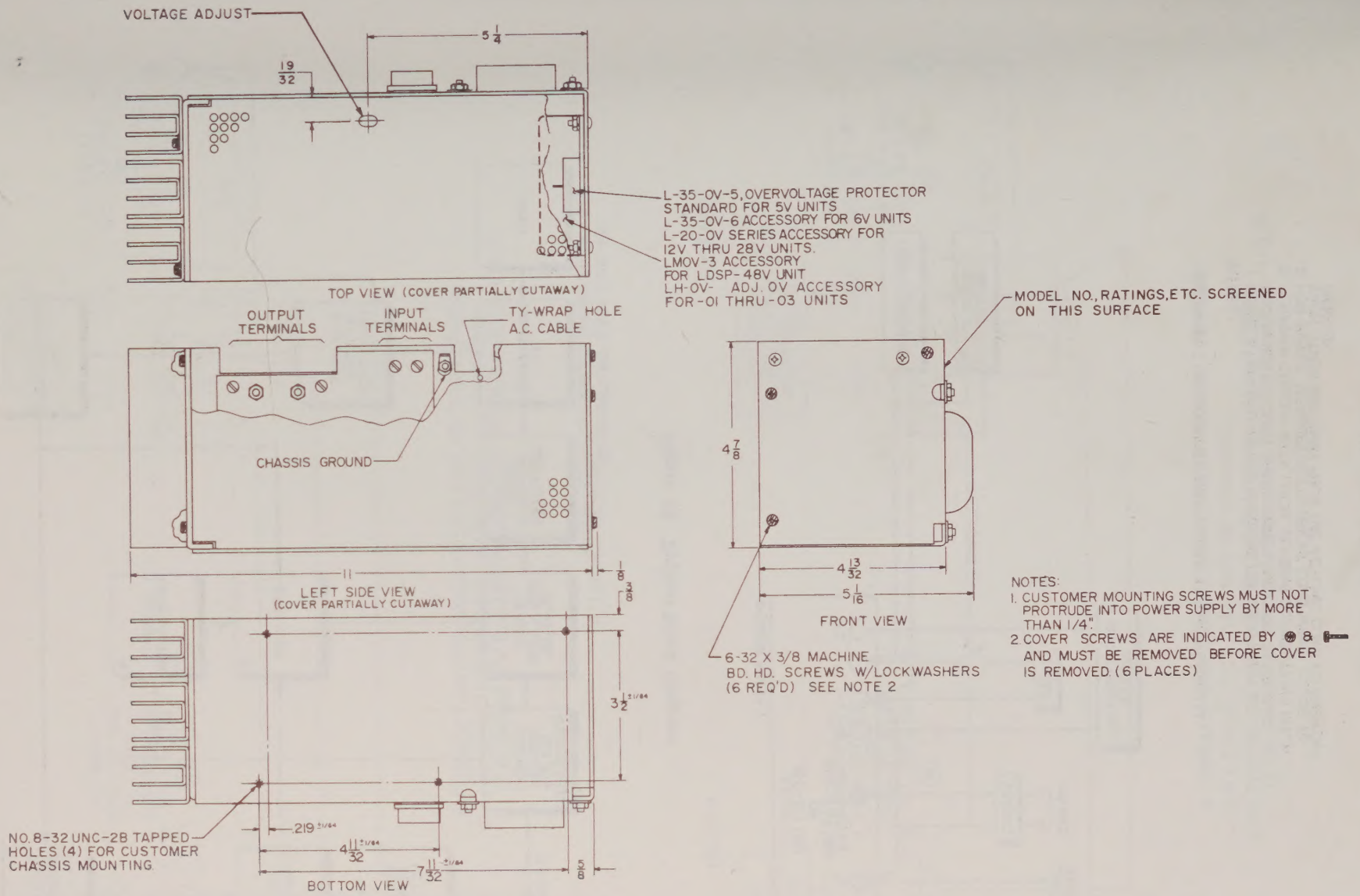
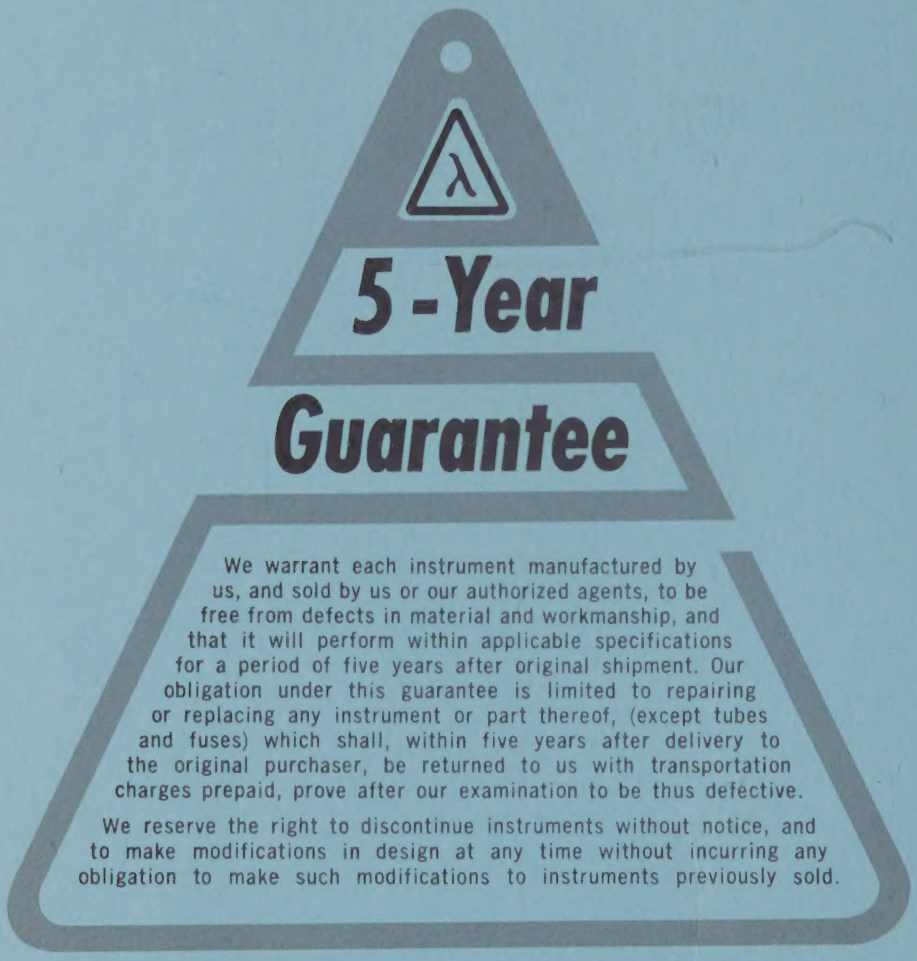


Figure 12. Outline Drawing.



5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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